ONE & Variable Delays

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Research Review

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Overview

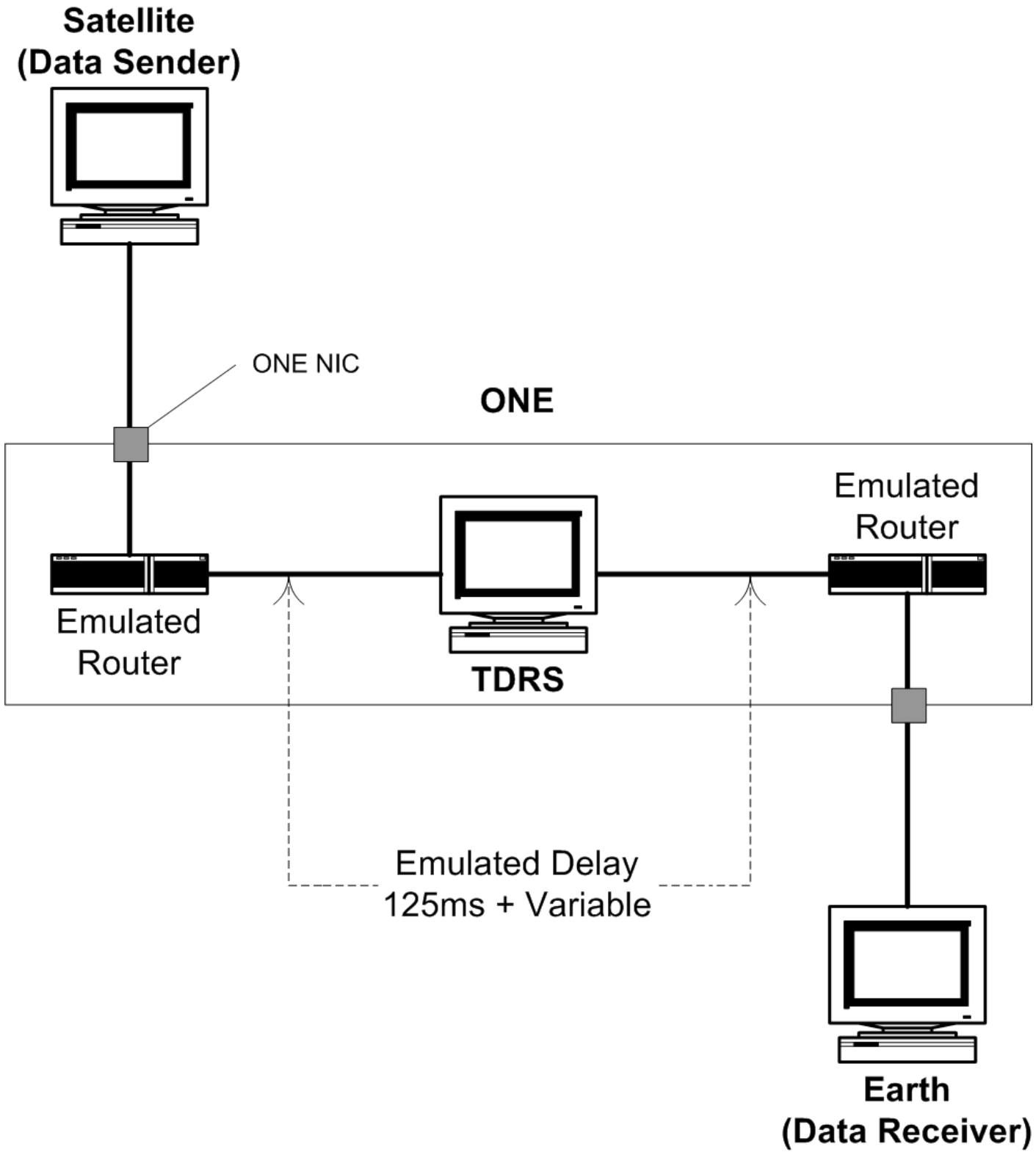
- Goals
- Testbed setup
- ONE's ability to handle variable delays
- Test setup
- Results
- Questions

Goals

- Validate that ONE can properly emulate variable delays
- Use ONE to analyze a scenario consisting of multiple satellites, and compare the results to previous simulations

Testbed Setup

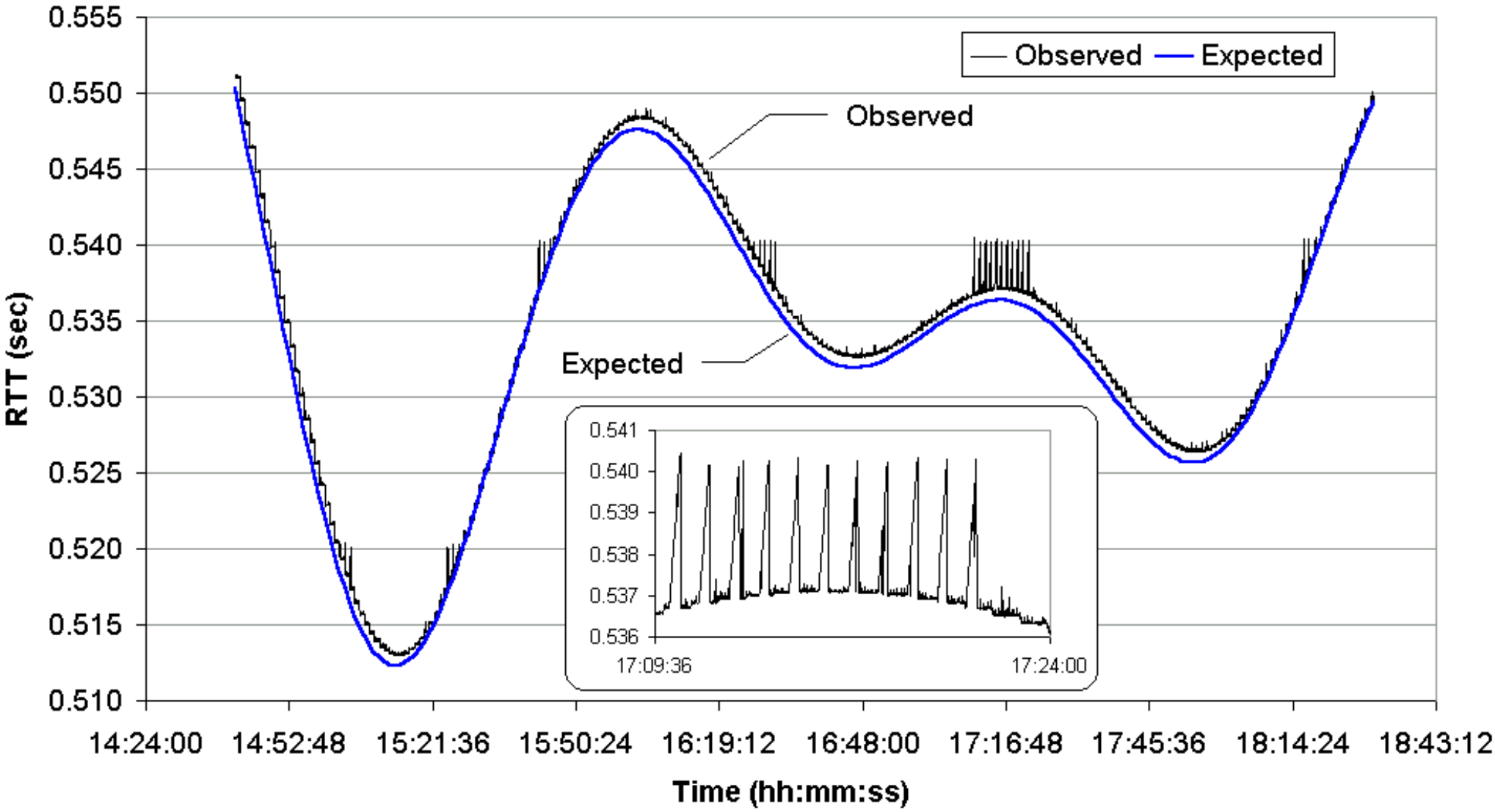
- LEO/MEO satellite talking to Earth through a GEO satellite
- Three machines
  - 2 OpenBSD machines
    - one acts as the sending source (the satellite)
    - the other acts as the receiver (the Earth)
  - Solaris machine which runs ONE
    - Emulates the path between the satellite and Earth


Satellite
(Data Sender)
ONE NIC
ONE
Emulated
Router
Emulated
Router
TDRS
Emulated Delay
125ms + Variable
Earth
(Data Receiver)

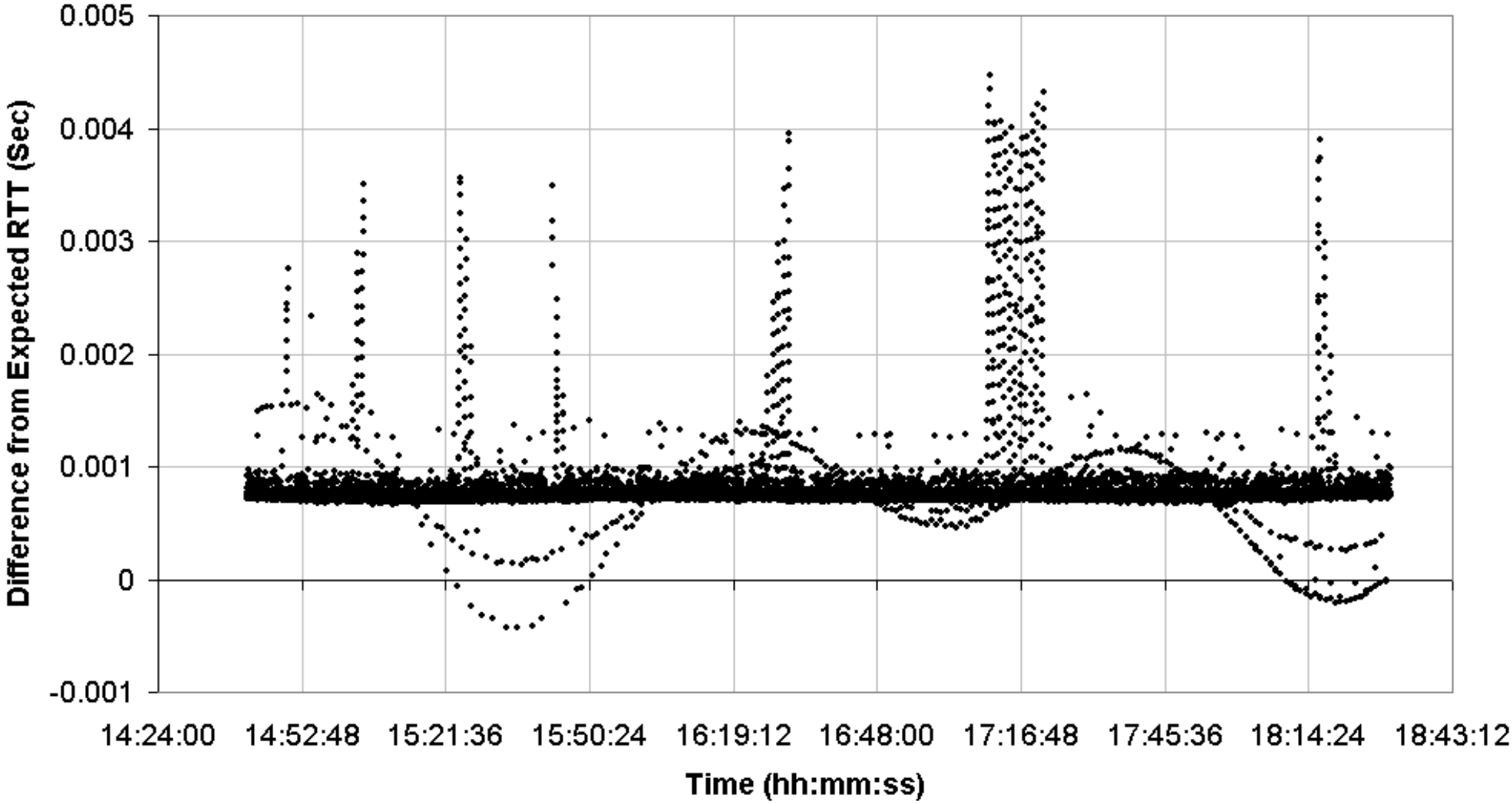
Validating ONE

- New version of ONE (3.0) on new version of Solaris (8) prompted for execution of basic tests
  - Used ‘ping’ to generate ICMP packets of various sizes, to test basic ONE functionality
- No documentation on ONE’s ability to properly emulate variable delays
  - Simple test devised

Observed vs. Expected RTT



Difference in the Observed from Expected Value of RTT



Test Setup

- 5 Different Orbital Scenarios
  - Patterns yield different amount and degree of variability in delay
- 4 Different File Sizes
  - Producing 2, 20, 200, and 2000 packet transfers
- Each file size and scenario selection coincides with the range found in the previous simulation study
  - Provides ground for good comparisons

Test Setup (cont.)

- TCP timer granularity varied between 10 and 500 milliseconds
- Minimum RTO of one second enforced for all tests
- TTCP used to transfer data from the sender to the receiver
- Packets were captured at the endpoints using tcpdump

Results

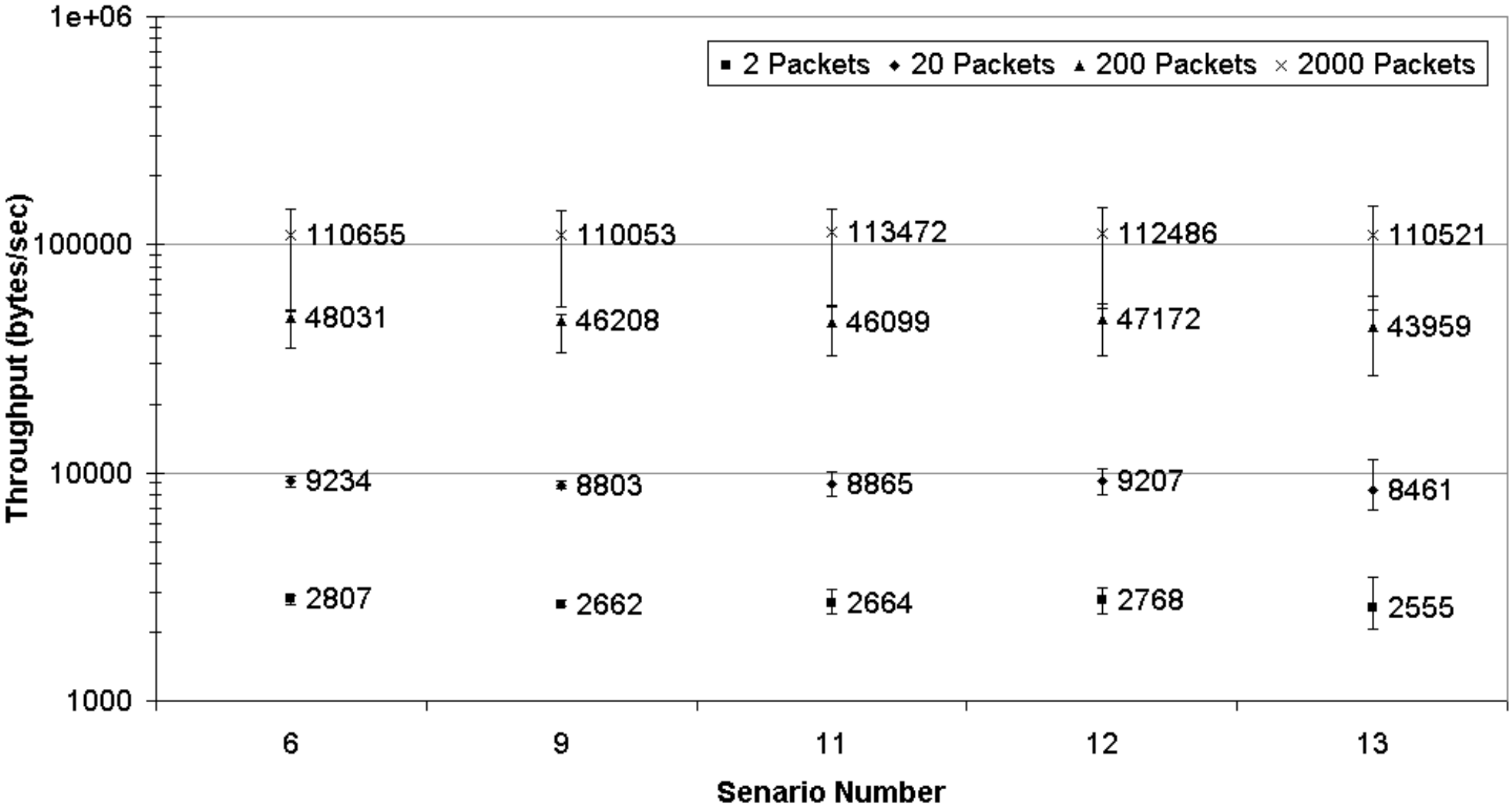
- Throughput
  - Increases as the file size increases
  - Does not vary by scenario
  - Greater variation for larger file sizes
    - Conflicts with past simulation results
- Link bandwidth near full utilization with large (2000 packet) transfers and granularity of 500 ms

Results (cont.)

- Adjusting the granularity to 10 ms decreases performance for 2000 packet transfers
- Observed spurious RTO under a granularity of 10 ms, causing a decrease in performance

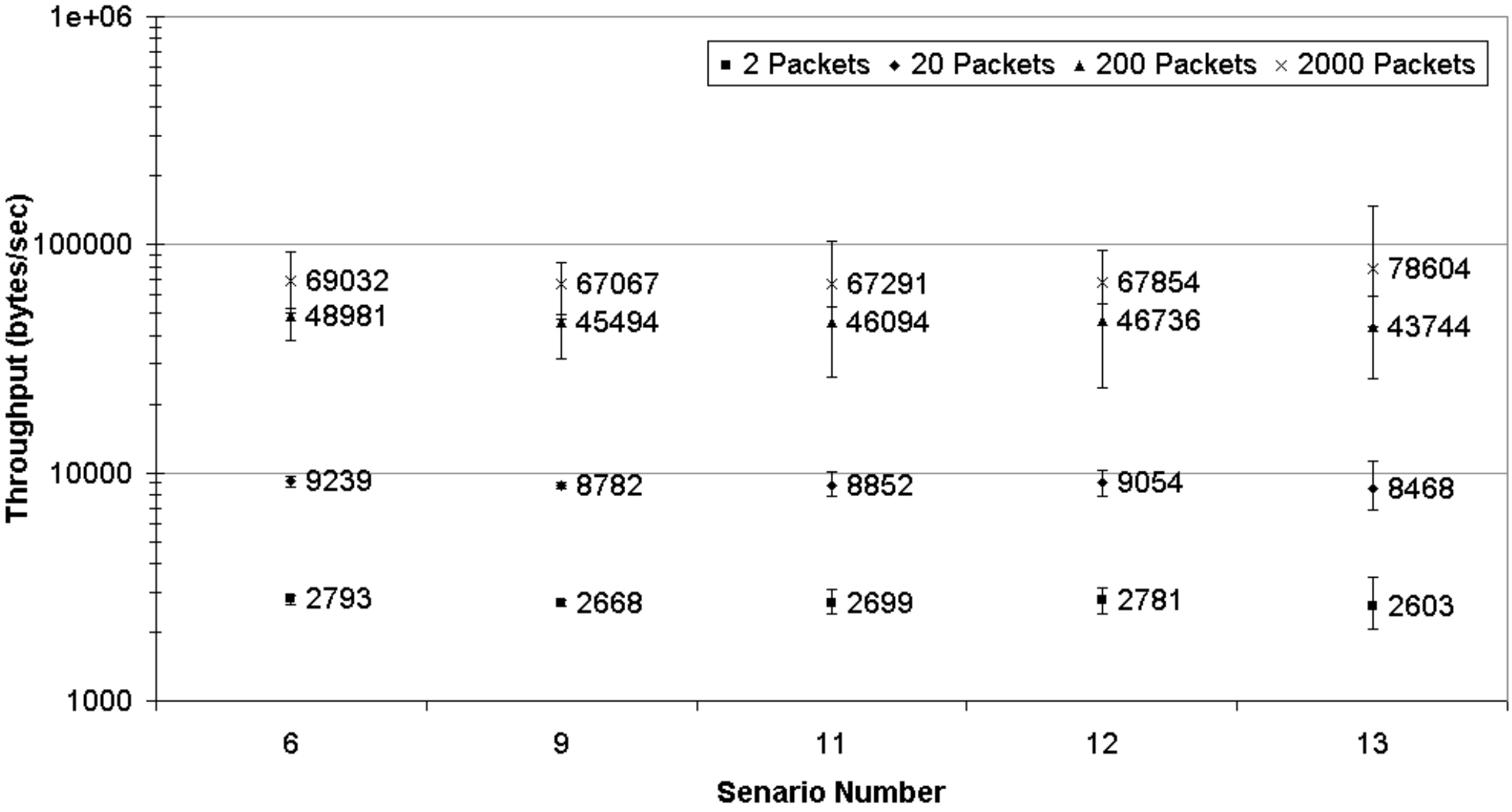
Average Throughput

Per Scenario and File Size (Granularity = 500 ms)



Average Throughput

Per Scenario and File Size (Granularity = 10 ms)



Conclusions

- ONE performs well in emulating a variable delay environment
- TCP is fairly robust to environments with large and varying round trip times, given an ample timer granularity and minimum RTO
- Throughput degrades significantly for larger file sizes when a finer granularity is used
- Performance variations increase at larger file sizes

Future Work

- Running similar tests with multiple flows
- Using additional hardware to
  - Introduce varying signal strength that corresponds to the variable delay
  - Model handoffs between different scenarios
- Further exploring the increase in throughput variations at larger file sizes